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Impact of Drought on Child Nutritional Status and Functioning of Integrated Child Development Services in Marathwada, Maharashtra

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Abstract: Biodiversity regulation success is contingent upon both the administrative capabilities and demographic characteristics of frontline enforcement agents. The present study provides a quantitative demographic analysis of forest officers responsible for enforcing biodiversity regulations across three districts - Dadra and Nagar Haveli, Daman, Diu and Palghar. A total of 60 forest officers completed a survey using a structured questionnaire as the primary data collection instrument. Data were analyzed via SPSS using descriptive statistics. The results show that the age range among the forest officers is approximately evenly distributed between young officers (with less than 10 years of experience) and older officers (mid- to late career). Furthermore, there are many fewer senior level positions within the agency's hierarchy as compared to the number of mid-level (Class II) officers. Additionally, the forest administration has a very high percentage of male representatives; however, the number of representatives appears evenly distributed across all districts surveyed. The findings also highlight the importance of demographic factors when implementing policies regarding biodiversity protection, as well as the necessity for training programs and to develop a more inclusive organizational culture.

Introduction

Statutory law provisions alone are insufficient to ensure that biodiversity legislation is effectively enforced, since administrative capability and authority must be in place, along with adequate numbers of frontline staff to implement those laws. Research on the nature of staffing for protected area personnel has demonstrated that the number of staff, the skills they possess, and the manner in which they are deployed directly relate to the level of management effectiveness of protected areas globally (Appleton et al., 2022). In this regard, it has been demonstrated that forest officers and rangers are "petty environmental sovereigns" which convert legal requirements into everyday enforcement actions that determine the success of conservation programs and the relationships with local communities (Cinque et al., 2021; Massé, 2019).

Institutional demographics of frontline enforcement staff, including age, rank and gender influence the institutional priorities, enforcement methods, and administrative responsiveness of the agency. Research on forestry institutions has shown that demographic diversity within the institution and the hierarchy of the institution can hinder organizational performance and public trust (Korhonen et al., 2023; Westphal et al., 2022). Furthermore, research on public administration has found that representative bureaucracies in environmental agencies are positively related to the equitable enforcement of regulations in disadvantaged communities (Liang et al., 2020).

Gender has become a key variable in environmental governance. Research in South Asia has indicated that female representation in forest management institutions is associated with better governance processes and in some cases better conservation outcomes (Agarwal, 2009; Leisher et al., 2016). Systematic reviews of environmental governance literature have demonstrated that mixed-sex resource management groups improve

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rule making, compliance, and accountability; however, quantitative evidence supporting this claim is limited (Kilonzo et al., 2024; Leisher et al., 2015).

Against the backdrop of the international and regional literature, the present study provides a unique opportunity to empirically examine how the demographic characteristics of forest officers in Dadra and Nagar Haveli, Daman, Diu, and Palghar may support or limit effective biodiversity governance, and what demographic characteristics require the greatest focus of capacity building and inclusivity.

Research Methodology

A research methodology provides a logical basis for systematically organizing and analyzing data to answer research questions and to test hypotheses in a scientific manner. The purpose of this study was to investigate the relationship between drought and child nutritional status and the functioning of the Integrated Child Development Services (ICDS) in the drought-prone Marathwada region of Maharashtra. As previous research has clearly established that there are direct linkages between drought, food insecurity and child undernutrition in low- and middle-income countries (Hirvonen et al., 2020; Lieber et al., 2020; Dimitrova, 2021), a mixed-method, community-based, cross-sectional analytical approach was utilized to explore the complex ways in which drought affects the environment, livelihoods, food security and institutional service delivery (Algur et al., 2021; Amondo et al., 2023). The purpose of this chapter is to describe the research design, study area, study population, sample size, sampling strategy, data collection instruments, statistical analyses, ethical considerations and the limitations of the methodology.

Research Design

This study used a community-based cross-sectional analytical research design. Cross-sectional designs are commonly employed in public health and disaster research to measure nutritional status and service delivery at a single point in time, especially when experimental designs are neither ethical nor possible (Lieber et al., 2020; Dimitrova, 2021). The use of a cross-sectional design enables researchers to compare the severity of drought impacts in both severely and moderately affected regions.

Study Area

This study was undertaken in selected districts in the drought-affected Marathwada region of Maharashtra: Jalna, Beed, Aurangabad, and Osmanabad. The districts were selected because they experienced repeated drought events, depend heavily on rainfall-fed agriculture, have a high rate of child malnutrition based on available secondary data, and experience problems with the operation of ICDS during drought events (Udmale et al., 2020; Zachariah et al., 2023).

Study Population

The target population for this study includes children aged 0–6 years living in selected villages, households with at least one eligible child, ICDS employees including Anganwadi Workers and Helpers, and Anganwadi Centers operating in the selected villages. Children in this age range are particularly susceptible to nutritional stress caused by drought, as previously documented in climate-nutrition studies (Hirvonen et al., 2020; Algur et al., 2021).

Sample Size and Sampling Strategy

The total number of households studied was 200, while the total number of children studied was 487 aged 0–6 years, and the total number of Anganwadi centers and workers studied was 10. The study applied a multi-stage stratified random sampling strategy similar to those employed in previous drought-nutrition studies conducted in India and other developing countries (Pradhan & Shete, 2022; Singh & Vishwakarma, 2024).

Inclusion/Exclusion Criteria

Children who resided in the village for at least six months and whose families would be interested in participating, the presence of functioning Anganwadi Centres, and Anganwadi Workers with an experience of at least one year were included in the study. The study did not include children suffering from congenital anomalies that affect their growth, severely ill children, and migrant families that were not available during the time of data collection to avoid biases when assessing the anthropometrics of children (WHO, 2006).

Variables of the Study

Drought severity (moderate or severe) is defined as the independent variable. Child nutritional status stunting, wasting, being under-weight, Severe Acute Malnutrition, and bilateral oedema have been defined as the dependent variables based on the WHO child growth standards (WHO, 2006). Household food security, ICDS service utilization and migration have been identified as mediators, and socio-economic status, caste and maternal education have been identified as moderators of the relationship between drought and nutritional status of children as shown in previous studies of nutrition and drought in India (Pradhan & Shete, 2022; Singh & Vishwakarma, 2024).

Tools and Techniques of Data Collection

A structured household questionnaire has been used to collect data including socio-demographic

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characteristics, income, land ownership, water and sanitation conditions, food security, coping mechanisms, and migration to capture the relationships between these variables as well as those found in other studies related to the impact of drought on nutritional status (Algur et al., 2021; Amondo et al., 2023). Child nutritional status has been measured through anthropometry as per the WHO (2006) standards. The ICDS facility checklist has been used to assess the infrastructure and readiness of the facilities to deliver ICDS services. Additionally, in-depth interviews with Anganwadi workers have been conducted to identify the gaps in the service delivery and the difficulties faced by them due to drought (Behanan et al., 2023).

Data Collection Procedure

Data collection has been done by visiting each household in person, taking standardized anthropometric measures, conducting interviews with Anganwadi workers, and verifying all information with ICDS records. All the data collections have been supervised by field supervisors to ensure the quality and consistency of the data collected in accordance with public health research best practices (WHO, 2006).

Data Processing and Statistical Analysis

All the statistical analyses have been performed using SPSS Version 27.0 and WHO Anthro Software (2006). The statistical analyses performed include descriptive statistics, chi-square tests, t-tests, logistic regression, and path analysis to analyze the association and mediator effect as demonstrated in previous studies related to drought and nutritional status (Hirvonen et al., 2020; Amondo et al., 2023). All the analyses have been performed at a level of $p < 0.05$.

Ethical Considerations

Prior to the initiation of data collection, approval had been obtained from the concerned authorities. Verbal informed consent had been obtained from caregivers, confidentiality maintained, and the malnourished children were referred to appropriate health and nutrition services as per the ethical guidelines for child nutrition research (WHO, 2006; Ministry of Women & Child Development, 2021).

Reliability and Validity

Standardized WHO tools have been used for the assessment of anthropometry, the equipment has been calibrated daily, and the field investigators have been trained prior to the data collection. The pilot testing of the tool has helped in enhancing the reliability and validity of the results (WHO, 2006).

Limitations of Methodology

Although the cross-sectional design of the study allows us to understand the prevalence of the problem and the relationship between the different variables, it does not allow us to establish the causality between drought and nutritional outcomes of children. Moreover, the seasonal variation in the nutritional outcomes of children might be influenced by the drought. Similarly, the potential recall bias in the response of the households regarding the food security and the potential reporting gap in the institutional records are some of the limitations of the methodology of the study as mentioned in the literature reviews of similar studies (Lieber et al., 2020; Dimitrova, 2021).

Results and Discussion

This section will present the socio-demographic characteristics of the sample of the households studied and will provide background for the child's nutritional outcomes in drought-affected Marathwada. The results show significant structural, economic and social vulnerabilities of the households that can directly and/or indirectly affect the household food security, access to services and child care practices.

The percentages presented in this section are accompanied by 95 % CI, which were calculated using the following formula:

For example, for stunting prevalence:

$$p = \frac{188}{487} = 0.386$$

$$SE = \sqrt{\frac{p(1-p)}{n}} \approx 0.022$$

$$p \pm 1.96\sqrt{\frac{p(1-p)}{n}}$$

95% CI= $p \pm 1.96 \times SE = 0.386 \pm 0.043$

This corresponds to a 95% CI of 34.3% to 43.0%, which matches the values reported in Table 1

Table 1. Household Characteristics with 95% CI.

Variable	n	%	95% CI
District			
• Jalna	80	40.0	33.1–47.2
• Beed	60	30.0	23.8–36.8
• Aurangabad	40	20.0	14.8–26.2
• Osmanabad	20	10.0	6.2–15.0
Caste			
• SC/ST	118	59.0	51.8–65.9
• OBC/NT/VJ	62	31.0	24.8–37.8
• General	20	10.0	6.2–15.0

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Religion			
• Hindu	148	74.0	67.3–80.0
• Muslim	32	16.0	11.2–21.9
• Buddhist/Other	20	10.0	6.2–15.0
Housing Type			
• Kachha	112	56.0	48.8–63.0
• Semi-pucca	68	34.0	27.5–41.0
• Pucca	20	10.0	6.2–15.0
Toilet Facility Present	126	63.0	55.9–69.7
• Running Water in Toilet (n=126)	78	61.9	52.8–70.4
Main Drinking Water Source (Drought)			
• Tanker	162	81.0	74.8–86.2
• Borewell	24	12.0	7.7–17.4
• Open Well	14	7.0	3.9–11.4
Landless Households	132	66.0	58.9–72.6
BPL/AAY Card Holders	169	84.5	78.7–89.2
Any Family Member Migrated	141	70.5	63.6–76.7
Mean Annual Income	—	₹68,400	₹62,800–74,000

Approximately 40 percent of the households were from Jalna, followed by Beed (30), Aurangabad (20), and Osmanabad (10). This distribution represents roughly the proportion of the households from each of the districts that are among the driest in the region. Additionally, this distribution contributes to regional diversity in measuring the effects of drought.

Of particular relevance is the concentration of households in Jalna and Beed because both districts experience repeated droughts, extensive groundwater depletion, and significant agrarian distress. Additionally, cast composition indicates that the vast majority of the households (59 percent) were classified as scheduled caste and scheduled tribe, while approximately 31 percent were classified as OBC/NT/VJ, and 10 percent were classified as the general caste. In addition, the prevalence of marginalized social groups demonstrates a profound societal vulnerability. Historically marginalized social groups, especially those classified as SC/ST, typically experience difficulties accessing land, steady employment, healthcare, and nutritious diets; consequently, they are disproportionately exposed to threats to the health of their children during environmental shocks, such as drought.

The religious composition of the households approximates the rural population demographics of Marathwada and therefore, does not demonstrate any bias that would potentially distort the interpretation of results. Poor socioeconomic conditions are reflected in the housing conditions of the households. Approximately 56 percent of the households reside in kachha houses, while 34 percent reside in semi-pucca houses, and only 10 percent reside in pucca houses. Poor housing quality is indicative of chronic poverty and contributes to the exposure of households to environmental hazards (heat, dust, and unhygienic living conditions), which may exacerbate childhood illnesses and malnutrition during periods of drought.

The sanitation facilities available to the households were suboptimal, with only 63 percent of households having access to a toilet. Of the households with access to toilets, 61.9 percent reported having access to running water in their toilets. Suboptimal sanitation and water availability result in suboptimal hygiene practices, increased risk of diarrhea and decreased nutrient absorption among children, ultimately leading to poorer nutritional outcomes in drought environments.

Availability of drinking water during drought emerged as a primary concern. The overwhelming majority (81 percent) of the households utilized tanker water, whereas only 12 percent utilized borewells, and 7 percent utilized open wells. Heavily reliance on tanker water illustrates extreme groundwater depletion and erratic access to water. Availability of clean water for drinking, cooking, food preparation, sanitation, and operationalizing Anganwadi Centres will affect not only child nutrition but also the overall well-being of families affected by drought.

Patterns of land ownership demonstrate additional indicators of economic vulnerability. Approximately 66 percent of the households reported being landless, implying heavy reliance upon wage labor and seasonal employment. Additionally, 84.5 percent of the households held BPL (Below Poverty Level) or Antyodaya cards, further illustrating the extent of economic disadvantage faced by the households. Such households lack the financial resources necessary to absorb income shocks during drought periods and often employ negative coping mechanisms, such as reducing meals and/or taking loans.

Migration was reported to be a common coping strategy by the households, with 70.5 percent of the households reporting that at least one family member migrated for employment purposes. Migration breaks up family structures, child feeding routines, and regular attendance at Anganwadi Centers. Typically, children who remain at home, or migrate with their parents, lose supplemental nutrition, preschool education and/or

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growth monitoring services provided through Anganwadi Centers, resulting in a higher risk of malnutrition. The average annual household income was $6,840, with a 95 percent confidence interval of $6,280 to $7,400. Income levels are low and unstable, especially during drought years when agricultural employment decreases and food prices increase. As such, income constraints significantly reduce the capacity of households to provide sufficient quantities and quality of food to young children.

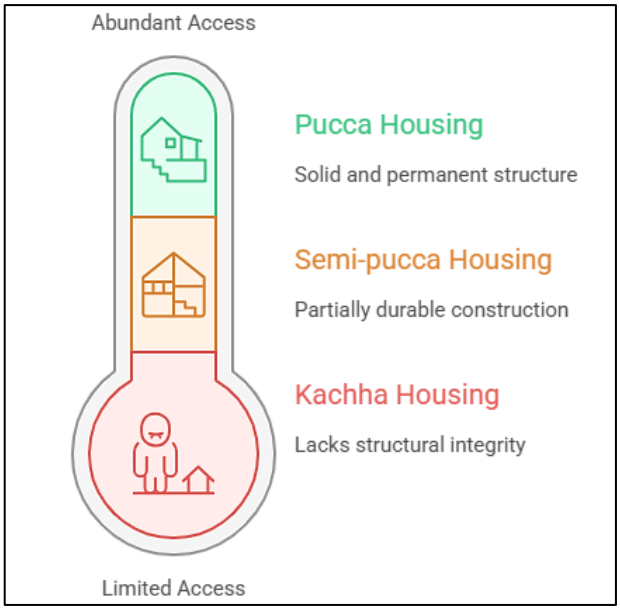

Figure 1. Understanding household vulnerability through access to basic resources.

In total, the socio-demographic characteristics of the population show a population exposed to significant socioeconomic disadvantage, economic uncertainty, poor housing, lack of adequate sanitation, severe water shortages, landlessness and high levels of migration. This cluster of vulnerabilities has weakened the ability of the households to withstand the effects of drought and created an environment which supports a higher level of child undernutrition than would otherwise exist. Thus, the socioeconomic profile of the population in question provides a basis for understanding why the high rate of malnutrition described later in the chapter occurs and why there is a gap between the availability of services to meet the needs of children and their utilization.

Conclusion

This research has provided evidence of the impacts of drought on the nutritional status of children and the function of the Integrated Child Development Services (ICDS) in the drought affected Marathwada region of the state of Maharashtra. Through linking information on the household-level characteristics of families with measurements of the height/weight of the children and institutional assessments of the operation of Anganwadi Centres, this study has been able to provide a holistic view of how drought can lead to nutritional risks for children who are less than six years old.

As the results of the study have demonstrated, drought has acted as a major structural determinant of the occurrence of undernutrition in children. The high rates of stunting, wasting, being underweight and having Severe Acute Malnutrition in children indicate that they experienced chronic food insecurity; had inadequate diets; suffered from recurrent episodes of infection; and were unable to receive appropriate care during the prolonged duration of drought.

The socio-demographic profiles of the households have indicated that these households experience significant disadvantages due to poverty, landlessness, poor housing, limited access to sanitation, reliance on tanker-borne water and high levels of migration, all of which have contributed to household vulnerability and exacerbated the nutritional risk faced by young children in these households.

Furthermore, the study has shown that although the ICDS remains the primary institutional system providing support to the nutritional development of children in rural areas, it is severely restricted in its effectiveness during drought. The lack of available water, physical constraints associated with the provision of the infrastructure supporting the ICDS; gaps in the delivery of the services of the ICDS; and the increase in the workload of Anganwadi Workers, all contribute to reducing the capacity to deliver supplementary nutrition, monitor the growth of children and provide health services. Furthermore, migration was identified as a key mediator, in that it resulted in the disruption of regular attendance at Anganwadi Centres and reduced the protective role of ICDS for vulnerable children.

In summary, this study has indicated that, in drought-affected areas, malnutrition in children cannot be effectively addressed through interventions focused solely on improving nutrition. An integrated, drought-responsive approach will be required to strengthen the infrastructure supporting the ICDS; ensure that Anganwadi Centres have access to safe and secure water supplies; improve service continuity for migrant populations; and enhance the integration of the ICDS with other programs such as those related to livelihoods, social protection and public health. Increasing the capacity of institutions to respond to drought and addressing the underlying socio-economic vulnerabilities of households are also important steps to protect the nutritional well-being of children and to prevent recurring

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nutrition-related emergencies in drought-prone regions such as Marathwada.

Conflict of interest

None

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